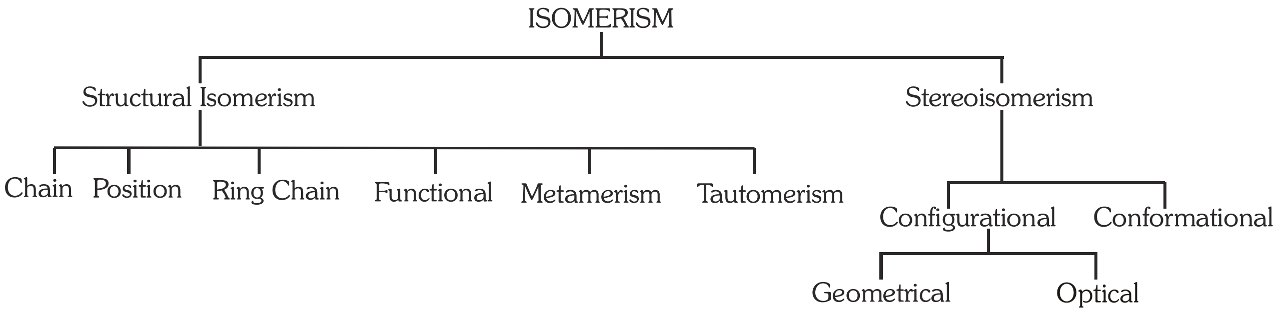
ISOMERISM

Two or more than two compounds having the same molecular formula but different physical/chemical or both properties are called isomers and the phenomenon is called isomerism.



2.1 Structural Isomerism

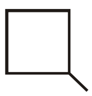
2.1.1 Chain Isomerism (C.I.)

The compounds which have same molecular formula, same functional group but different arrangement of carbon chain (Parental or side chain) show chain isomerism.

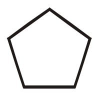
Ex. $CH_3—CH_2—CH_2—CH_3$ (Butane (4C)) and $CH_3—\underset{\substack{|\\ CH_3}}{CH}—CH_3$ (2–Methyl propane (3C))

Ex. $CH_3—CH_2—CH_2—CH_2—OH$ (1–Butanol (4C)) and $CH_3—\underset{\substack{|\\ CH_3}}{CH}—CH_2—OH$ (2–Methyl–1–propanol (3C))

Ex.



Methylcyclobutane



Cyclopentane

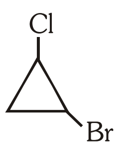
2.1.2 Position Isomerism (P.I.)

The compounds which have same molecular formula, same functional group, same parent carbon chain but different position of functional group or multiple bond or substituents, show position isomerism.

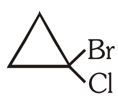
Ex. $CH_2{=}CH—CH_2—CH_3$ (But–1–ene) and $CH_3—CH{=}CH—CH_3$ (But–2–ene)

Ex. $CH_3—CH_2—CH_2—CH_2—OH$ (1–Butanol) and $CH_3—CH_2—\underset{\substack{|\\ OH}}{CH}—CH_3$ (2–Butanol)

Ex.



1-Bromo-2-chlorocyclopropane

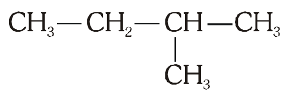


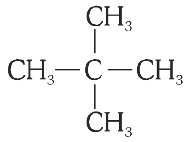
1-Bromo-1-chlorocyclopropane

Example of CI and PI :

(i) C_5H_{12} has three structural isomers :

$CH_3-CH_2-CH_2-CH_2-CH_3$



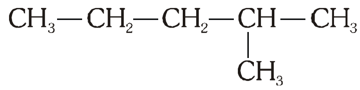


Pentane　　2–Methyl butane　　2,2–Dimethylpropane

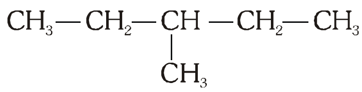
(ii) C_6H_{14} has 5 structural isomers

(a) $CH_3CH_2CH_2CH_2CH_2CH_3$

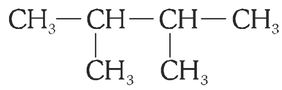
Hexane

(b) 

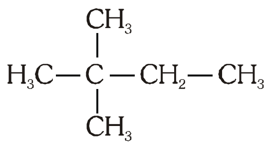
2–Methyl pentane

(c) 

3–Methyl pentane

(d) 

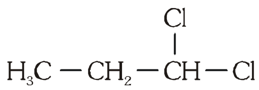
2,3–Dimethyl butane

(e) 

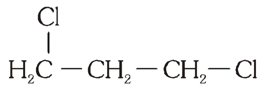
2,2–Dimethyl butane

- (a–b), (a–c), (a–d), (a–e) ⟶ Chain Isomers
  (b–d), (b–e), (c–d), (c–e)
- b–c, d–e ⟶ Position Isomers

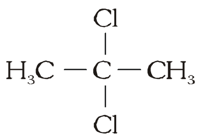
(iii) $C_3H_6Cl_2$ has 4 isomers : Position of chlorine atom is different in all the structure, so these are position Isomers.

a. 

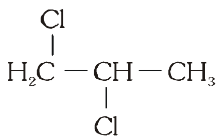
1,1–Dichloropropane

b. 

1,3–Dichloropropane

c. 

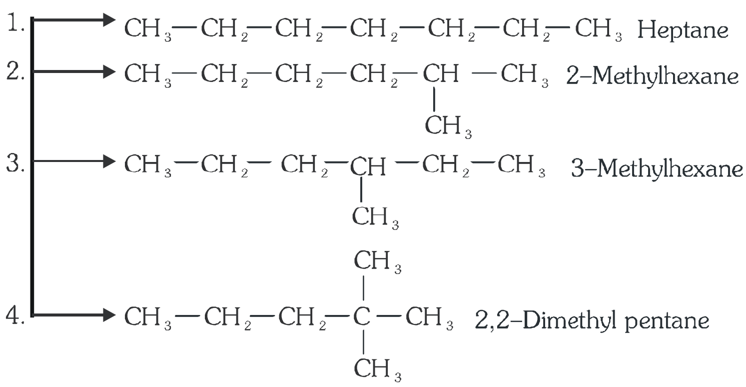
2,2–Dichloropropane

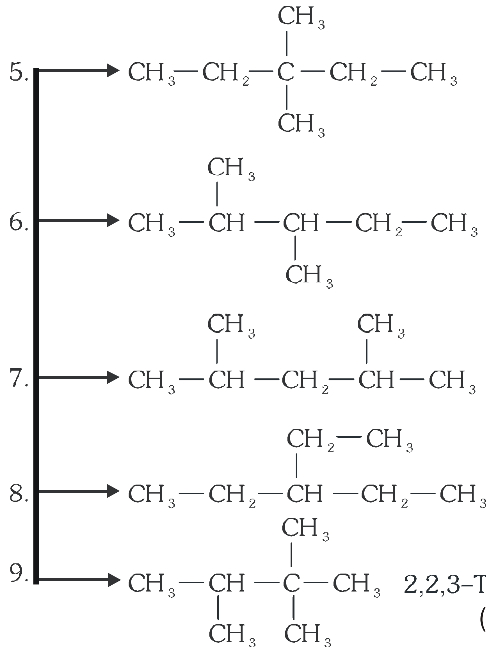
d. 

1,2–Dichloropropane

Ex. How many structural isomers of C_7H_{16} are possible ?

Ans. (9)





3,3-Dimethylpentane

2,3-Dimethylpentane

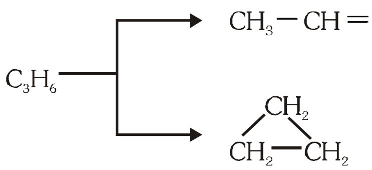
2,4-Dimethylpentane

3-Ethylpentane

2,2,3-Trimethylbutane
(Triptane)

2.1.3 Ring chain isomerism (RCI)

Same molecular formula but different mode of linking (open chain & closed chain) of carbon atoms.



[open chain]

[closed chain or ring]

GOLDEN KEY POINTS

- Alkenes with cycloalkane and alkynes and alkadienes with cycloalkenes show Ring-chain Isomerism.
- Ring-chain Isomers are also Functional Isomers but priority must be given to Ring-chain Isomers.

2.1.4 Functional Isomerism

Same molecular formula but different functional groups.

Following compounds show Functional isomerism, as they have same molecular formula and different functional group.

(i) Alcohol and Ether $\longrightarrow$ CH_3-CH_2-OH and CH_3-O-CH_3

(ii) Aldehydes and Ketones $\longrightarrow$ $CH_3-CH_2-\underset{\underset{O}{\|}}{C}-H$ and $CH_3-\underset{\underset{O}{\|}}{C}-CH_3$

(iii) Acids and Ester $\longrightarrow$ $CH_3-\underset{\underset{O}{\|}}{C}-OH$ and $H-\underset{\underset{O}{\|}}{C}-O-CH_3$

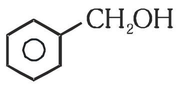
(iv) Cyanide and Isocyanide $\longrightarrow$ $CH_3-CH_2-CH_2-CN$ and $CH_3-CH_2-CH_2-NC$

(v) Nitro and Nitrite $\longrightarrow$ $CH_3-CH_2-N\begin{smallmatrix}\nearrow O\\ \searrow O\end{smallmatrix}$ and $CH_3-CH_2-O-N=O$

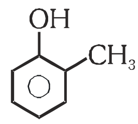
(vi) 1°, 2°, 3° Amines

(i) $CH_3-CH_2-CH_2-NH_2$ (ii) $CH_3-NH-CH_2-CH_3$ (iii) $CH_3-\underset{}{N}(CH_3)-CH_3$

(vii) Alcoholic and Phenolic compounds :



and



(viii) Alkyl halides do not show Functional isomerism.

(ix) $CH_3-C\equiv CH$ propyne and $CH_2=CH=CH_2$ allene

2.1.5 Metamerism

Same molecular formula, same polyvalent Functional group but different alkyl groups attached to polyvalent Functional group.

Polyvalent Functional group [Which have more than one valency] are :

$-O-$, $-S-$, $-\overset{\displaystyle O}{\overset{\|}{C}}-$, $-\overset{\displaystyle O}{\overset{\|}{C}}-O-$, $-\overset{\displaystyle O}{\overset{\|}{C}}-NH-$, $-NH-$, $-\underset{|}{N}-$, $\begin{matrix}-C(=O)\\ -C(=O)\end{matrix}\!\!>O$, $-\overset{\displaystyle O}{\overset{\|}{C}}-\underset{|}{N}-$

Ex. $CH_3-O-CH_2-CH_2-CH_3$; $H_3C-CH_2-O-CH_2-CH_3$

Ex. $CH_3-CH_2-NH-CH_2-CH_3$ $CH_3-NH-CH_2-CH_2-CH_3$

Ex. $CH_3-NH-CH_2-CH_2-CH_2-CH_3$ $H_3C-CH_2-NH-CH_2-CH_2-CH_3$

Ex. $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2-CH_2-CH_2-CH_3$ $CH_3-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2-CH_2-CH_3$

Examples Based on Structural Isomerism :-

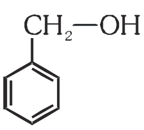
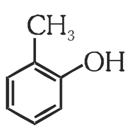
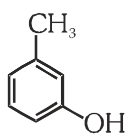
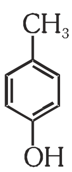
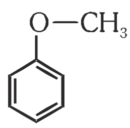
Ex. 1 $C_4H_{10}O$ Structural isomers $\Rightarrow$7 [4 alcohol and 3 ethers] total 7 structural isomers are possible.

Alcohol : $CH_3-CH_2-CH_2-CH_2-OH$ $CH_3-CH_2-\underset{OH}{\underset{|}{CH}}-CH_3$

$CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-OH$ and $CH_3-\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}-OH$

Ethers : $CH_3-O-CH_2-CH_2-CH_3$, $C_2H_5-O-C_2H_5$, $CH_3-O-\underset{CH_3}{\underset{|}{CH}}-CH_3$

Ex. 2 Aromatic isomers of C_7H_8O.

(a)  (b)  (c)  (d)  (e) 

- a, b – Functional isomers
- c, d – Position isomers
- a, e – Functional isomers
- b, c – Position isomers
- a, d – Functional isomers
- a, c – Functional isomers

Note : Alcoholic and phenolic groups are Functional isomers.

BEGINNER'S BOX-1

1. Structures $CH_3-CH_2-CH=CH_2$ and $CH_3-\underset{\substack{|\\CH_3}}{C}=CH_2$ are :–

(1) Chain isomers (2) Position isomers

(3) Both chain & position isomers (4) Not isomers

2. How many minimum carbons required for Chain isomerism and Position isomerism in alkanes ?

(1) 4, 5 (2) 3, 5 (3) 4, 6 (4) 4, 4

3. How many minimum carbons required for Chain isomerism and Position isomerism in alkenes ?

(1) 4, 5 (2) 3, 4 (3) 4, 4 (4) 5, 5

4. How many minimum carbons required for Chain isomerism and Position isomerism in alkynes ?

(1) 5, 4 (2) 5, 3 (3) 4, 6 (4) 4, 4

5. $CH_3-CH=CH-CH_3$ and $\begin{array}{c}CH_2-CH_2\\ |\qquad\ |\\ CH_2-CH_2\end{array}$ are :–

(1) Ring-chain Isomers (2) Chain Isomers (3) Functional Isomers (4) Position Isomers

6. $CH_3-CH_2-CH_2-\overset{\substack{O\\ \|}}{C}-OH$ and $CH_3-CH_2-\underset{\substack{|\\OH}}{CH}-\overset{\substack{O\\ \|}}{C}-H$ are

(1) Position isomers (2) Functional isomers (3) Identical (4) Chain isomers

7. $CH_3-S-CH_2-CH_3$ and $CH_3-CH_2-S-CH_3$ are –

(1) Ring-chain Isomers (2) Chain Isomers (3) Functional Isomers (4) Identical

8. $CH_3-\overset{\substack{O\\ \|}}{C}-O-\overset{\substack{O\\ \|}}{C}-C_6H_5$ and $C_6H_5-\overset{\substack{O\\ \|}}{C}-O-\overset{\substack{O\\ \|}}{C}-CH_3$ are –

(1) Metamers (2) Chain Isomers (3) Identical (4) Position Isomers

---

2.2 Stereo Isomerism

Two or more than two compounds having same molecular formula, same structural formula but different arrangements of atoms or groups in space.

(A) Configurational Isomerism : Stereo isomers which have following characteristics.

(a) Stereo isomer which cannot interconvert at room temperature due to restricted rotation known as Geometrical isomerism.

(b) Stereo isomers which have different behaviour towards plane polarised light are known as optical isomers.

(B) Conformational Isomerism

2.2.1 Geometrical isomerism (G. I) :

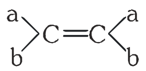
(i) Alkenes ($>C=C<$), oximes ($>C=N-OH$) and azo compounds [$-N=N-$] etc., show G. I. due to restricted rotation about double bond and (ii) cycloalkanes show G. I. due to restricted rotation about single bond in ring.

G. I. IN ALKENES :

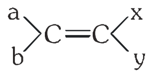
Reason : Restricted rotation about double bond :

Condition for Geometrical isomerism :

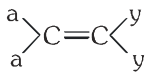
Only those alkenes show G. I. in which "Each sp^2 carbon individually have different atoms or groups"



Geometrical isomerism possible



Geometrical isomerism possible



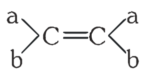
Geometrical isomerism not possible

Geometrical isomerism not possible

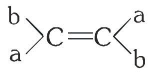
Nomenclature Systems of Geometrical isomers

(a) Cis–Trans System

If same groups are at same side then cis and if same groups are at different side then trans.

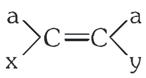


[Same groups, same side]
cis

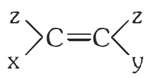


[Same groups different side]
trans

Ex.

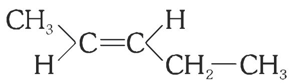


cis

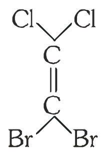


cis

Ex.



trans-2–pentene

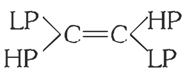


It does not show Geometrical isomers
So no cis–trans

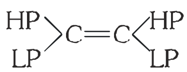
(b) E – Z System :

E (Entgegen) : When high priority groups are at opposite side.

Z (Zusamman) : When high priority groups are at same side.



'E'

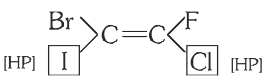


'Z'

HP – High priority and LP – Low priority

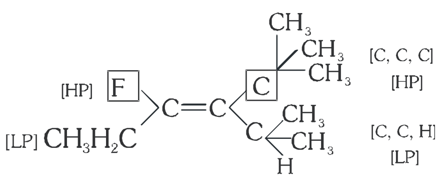
Priority Rules [CIP Sequence Rule] :

Rule I : Priority is proportional to atomic number of atom which is directly attached to sp^2 carbon.



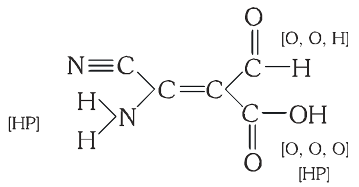
'Z'

Rule II : If rule-I is failed then consider the atomic number of next atom and so on.



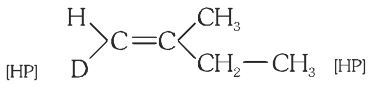
'Z'

Rule III :– If multiple bond is present then consider them as :-



'Z'

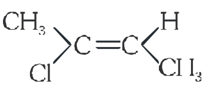
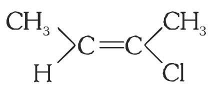
Rule IV : If isotopes are present then consider atomic weight.

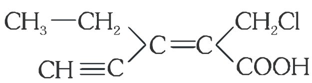
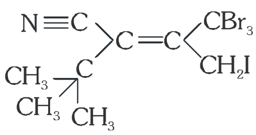


'Z'

BEGINNER'S BOX-2

1. Assign correct E, Z configuration to following molecules :-

(1)  (2) 

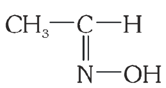
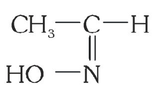
(3)  (4) 

GEOMETRICAL ISOMERS IN OXIMES [>C = N–OH] :

- Oximes show G. I. due to restricted rotation about double bond.
- Only those oximes show Geometrical isomerism in which sp^2 carbon have two different groups.

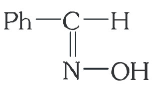
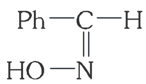
$$CH_3—CH\boxed{=O + H_2}N—OH \longrightarrow CH_3—CH=N—OH \text{ (oxime)}$$

Ex. Acetaldoximes has two Geometrical isomers –

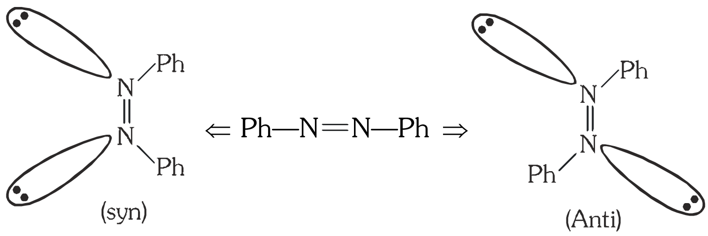
syn anti

When H and OH are on the same side. When H and OH are on the opposite side

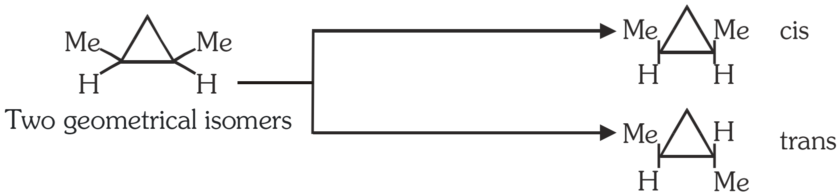
Ex. Benzaldoxime  

[Syn.] [Anti]

GEOMETRICAL ISOMERS IN AZO COMPOUNDS : $(-\ddot{N}=\ddot{N}-)$



GEOMETRICAL ISOMERS IN CYCLOALKANES : Cycloalkanes show Geometrical isomerism due to restricted rotation about single bond. Only those cyclo alkanes show Geometrical isomers in which atleast two different carbons have two different groups.



NUMBER OF GEOMETRICAL ISOMERS IN POLYENES :

R_1—CH=CH—CH=CH .... CH=CH—R_2

(a) If $R_1 \neq R_2$ then number of Geometrical isomers = 2^n

[n = number of double bonds which show G.I.]

Ex. CH_3—CH=CH—CH=CH—CH=CH—CH_2CH_3

As n = 3, number of Geometrical isomers = $2^3 = 8$

(b) If $R_1 = R_2$ then number of Geometrical isomers = $2^{n-1} + 2^{p-1}$

where $p = \frac{n}{2}$ (when n is even) and $p = \frac{n+1}{2}$ (n is odd)

Ex. CH_3—CH=CH—CH=CH—CH=CH—CH_3 [n = 3]

Number of Geometrical isomers = $2^2 + 2^1$

= 4 + 2 = 6

BEGINNER'S BOX-3

1. Which of the following shows Geometrical isomerism –

(a) CH_3—CH_2—CH=N—OH

(b) H_2C=N—OH

(c) CH_3—C(=N—OH)—CH_3

(d) CH_3—C(=N—OH)—CH_2CH_3

(1) a, c (2) c, d (3) a, d (4) b, c

2. Which of the following show Geometrical isomerism –

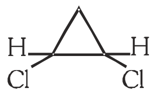
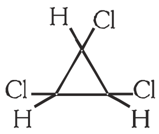
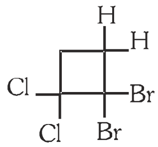
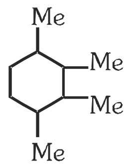
(1) 1,1–Diphenyl–1–butene

(2) 1,1–Diphenyl–2–butene

(3) 2,3–Dimethyl–2–butene

(4) 3-Phenyl–1–butene

3. Which of the following show Geometrical isomerism –

(a)  (b)  (c)  (d) 

(1) a, b, d (2) a, c, d (3) a, b, c (4) b, c, d

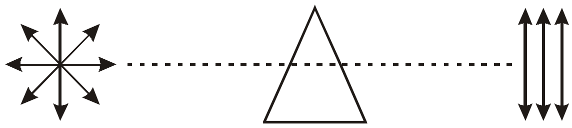
4. Calculate total number of geometrical isomers in the following compound

$CH_3—CH=CH—CH=CH—CH=CH—C_6H_5$

(1) 2 (2) 4 (3) 6 (4) 8

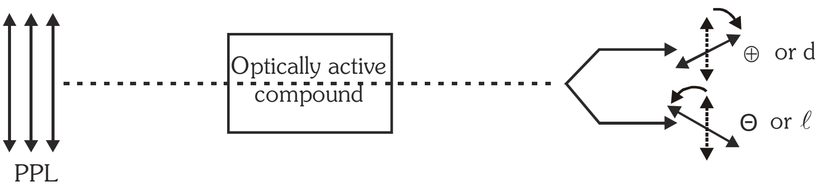
2.2.2 OPTICAL ISOMERISM :

Optical isomers : Two or more than two compound have same molecular formula, same structural formula but different behaviour towards PPL (plane polarised light).

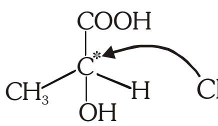


Non polarised Nicol prism Polarised light

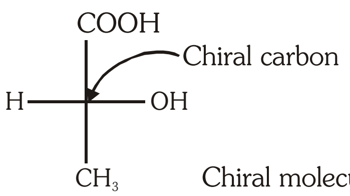
Optical activity : Tendancy to rotate plane of PPL in a particular direction. If a compound rotates plane of PPL in clockwise direction then it will be dexterorotatory or d or (+) and if a compound rotates plane of PPL in anticlockwise direction then it will be leavorotatory or ℓ or (–).



Chiral carbon : Carbon which is bonded to four different atoms or groups.

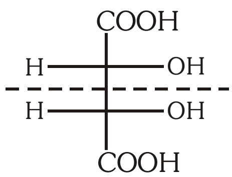
 Chiral carbon or asymmetric carbon.

Chiral molecule : (i) A molecule having only one chiral centre then it will be always chiral. Except flipping



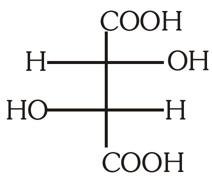
Chiral molecule

(ii) A molecule having atleast two chiral carbons and no symmetry then it will be chiral molecule.



Plane of symmtery

(Achiral molecule)



No symmetry

(Chiral molecule)

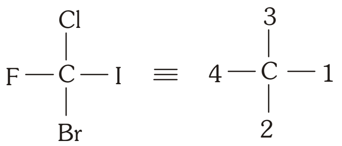
Essential and sufficient condition for optical activity is :
"Molecule should be **chiral**"
or
"Molecule should be **unsymmetrical**"
or
"**Nonsuperimposable** mirror images"

Absolute Configuration (R, S configuration) :

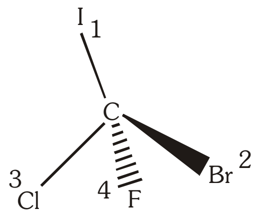
The actual three dimensional arrangement of groups in a molecule containing asymmetric carbon is termed as **absolute configuration**.

(R) (S) nomenclature is assigned as follows :

1. Each group attached to stereocentre is assigned a priority on the basis of CIP sequence rule.

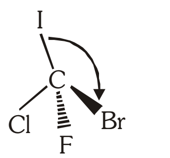
Example : 

2. After assigning priorties, the least priority group is written at remotest valency (going away).

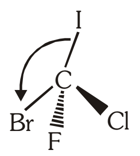


Note that priority order is : I > Br > Cl > F

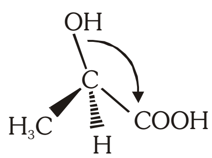
◆ Now the order from top priority to second priority and then to the third priority is determined. If it gives a clockwise direction then it is termed R configuration and if the anticlockwise direction is obtained then it is assigned S configuration. For example.



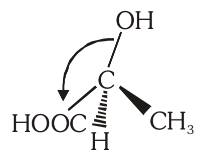
R-configuration
(clockwise from top priority)



S-configuration
(Anti clockwise from top priority)



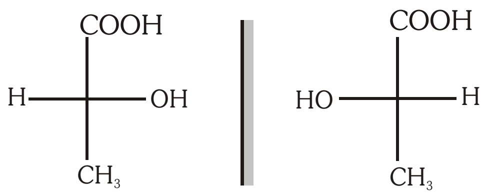
R-configuration
(clockwise from top priority)



S-configuration
(Anti clockwise from top priority)

Enantiomers :

Stereoisomers which are mirror images to each other and not superimpose to each other. Nonsuperimposable mirror images are called as enantiomers.



object (I) mirror image (II)

I and II are nonsuperimposable mirror images, so I and II are enantiomers.

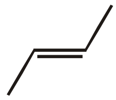
(i) Enantiomers have chiral structures.

(ii) Enantiomers are optically active substances. They rotate the plane polarized light in opposite directions but to the equal extent.

Diastereomers : Stereoisomers which are not mirror images of each others.

cis–2 butene

(I)



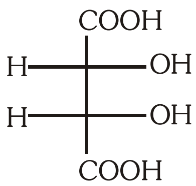
trans–2–butene

(II)

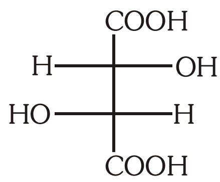
I and II are not mirror images, so I and II are diastereomers.

EXAMPLES OF OPTICAL ISOMERISM

Example : (1)

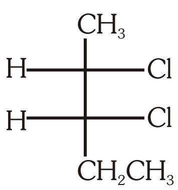


(2)

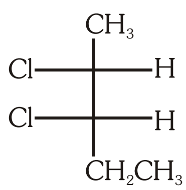


(1) and (2) are diastereomers.

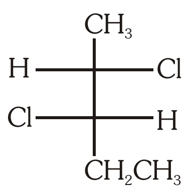
Example :



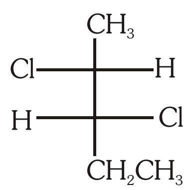
(I)



(II)



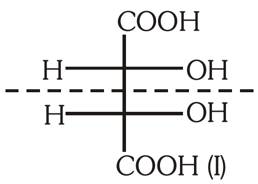
(III)



(IV)

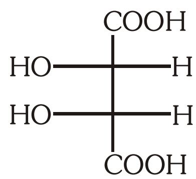
I, II	= Enantiomers,	III, IV	= Enantiomers
I, III	= Diastereomers,	II, IV	= Diastereomers
II, III	= Diastereomers,	I, IV	= Diastereomers

Example :



(I)

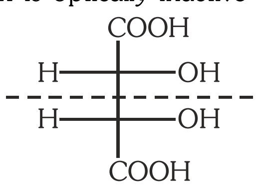
Achiral



(II)

I and II are identical

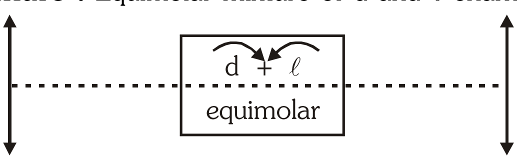
Meso compounds : Compounds having atleast two chiral carbons and plane of symmetry/cos/symmetry is called meso compounds. It is optically inactive due to internal compensation.



Plane of symmetry

(Achiral molecule optically inactive)

Racemic mixture : Equimolar mixture of d and ℓ enantiomers is called as racemic mixture. (dℓ or $\pm$).



Net rotation zero

[External compensation]

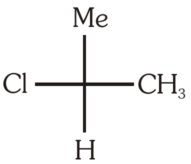
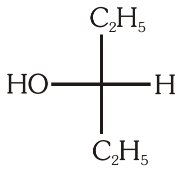
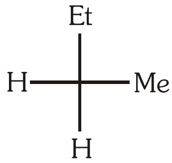
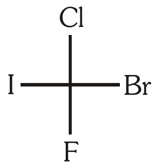
"Racemic mixture is optically inactive due to external compensation.

BEGINNER'S BOX-4

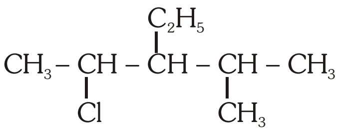
1. Which of the following molecule is chiral :-

(1) Isobutane (2) Neopentane (3) Sec. butylchloride (4) All

2. Which of the following molecule has chiral carbon :-

(1) 
(2) 
(3) 
(4) 

3. How many chiral carbon atoms are present in following molecule :-

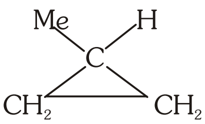


(1) 1 (2) 2 (3) 3 (4) 4

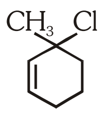
Number of stereoisomers :

S.N.	Nature of compounds	No. of optically active isomers (a)	No. of meso compounds (m)	Total no. of Stereoisomer (a + m)
1	Compounds having dissimilar ends	2^n (n = No. of chiral centre)	0	$(2^n + 0)$
2	Compounds having similar ends with even chiral centres	2^{n-1}	$2^{\frac{n}{2}-1}$	$(2^{n-1} + 2^{\frac{n}{2}-1})$
3	Compounds having similar ends with odd chiral centres	$2^{n-1} - 2^{\frac{n-1}{2}}$	$2^{\frac{n-1}{2}}$	2^{n-1}

Optical Isomerism in cyclic compounds :

(i) 

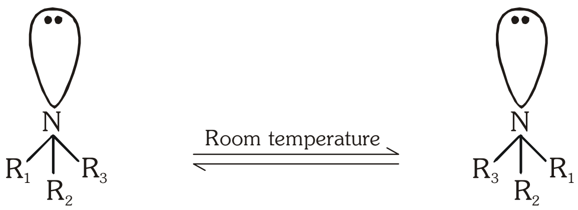
No chiral carbon,
Molecule is achiral
Molecule is optical inactive

(ii) 

Chiral carbon,
Chiral molecule,
Optically active

Special Point :

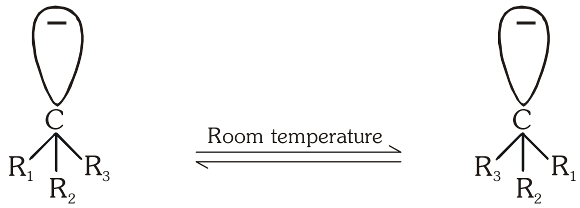
1. Chiral nitrogen containing/tertiary/open chain amine does not show optical isomerism
Reason :- Rapid umbrella inversion.



(I) (II)

Energy required for this interconversion is available at room temperature. So I and II are interconvertible.

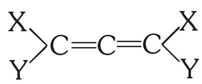
2. Chiral C containing carbanion does not show optical isomerism.
Reason :- Rapid umbrella inversion.



(I) (II)

Energy required for this interconversion is available at room temperature. So I and II are interconvertible.
Note :- Only 2nd period elements show flipping.

3. Substituted Allenes do not have chiral carbons but molecule is chiral, so show optical isomerism.

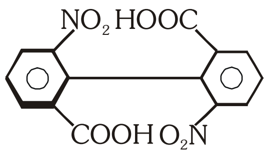
$CH_2=C=CH_2 \longrightarrow$ 

Allene

(No chiral C but molecule is chiral)

Only those substituted allenes will be optically active in which "each sp^2 C have different atoms or group".

4. Ortho substituted biphenyl compounds do not have any chiral carbon but due to chiral molecule, they are optically active.



Horizontal plane Vertical plane

BEGINNER'S BOX-5

1. Calculate total number of optical isomers in following compound :-

$$CH_3-\underset{OH}{\underset{|}{CH}}-\underset{OH}{\underset{|}{CH}}-CH_3$$

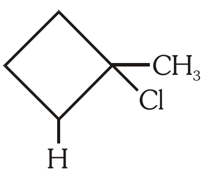
(1) 4 (2) 3 (3) 2 (4) 1

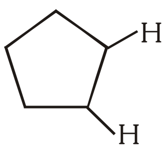
2. Calculate total number of optical isomers in following compound :-

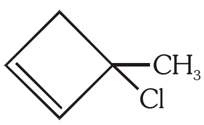
$$CH_3-\underset{OH}{\underset{|}{CH}}-\underset{OH}{\underset{|}{CH}}-\underset{OH}{\underset{|}{CH}}-CH_3$$

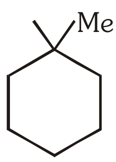
(1) 2 (2) 4 (3) 3 (4) 8

3. Which of the following is optically active :-

(1) 

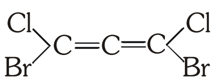
(2) 

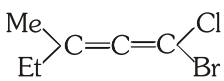
(3) 

(4) 

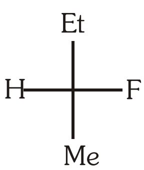
4. Which of the following is not optically active –

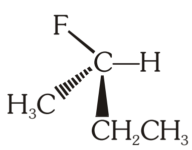
(1) $CH_3-CH=C=CH-CH_3$ (2) $CH_2=C=CH_2$

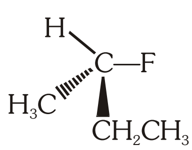
(3) 

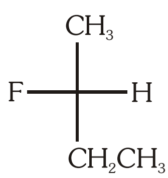
(4) 

5. Which of the following has 'S' configuration :-

(1) 

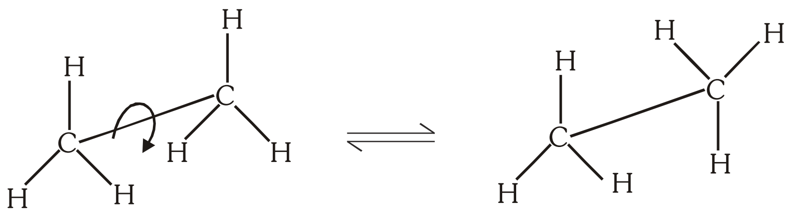
(2) 

(3) 

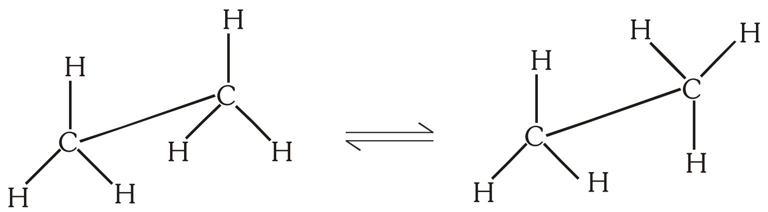
(4) 

(B) Conformational Isomerism

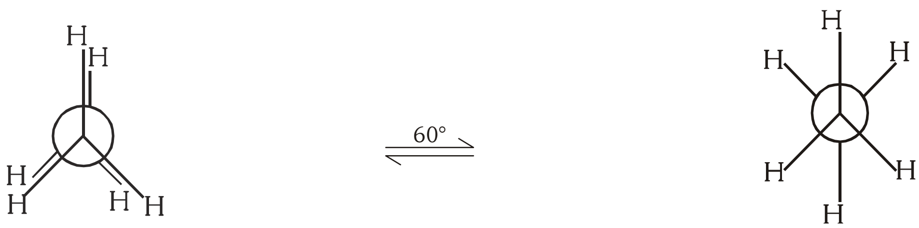
The different arrangement of atoms in space that result from the free rotation around single bond, are called conformations. The phenomenon is called conformational isomerism



Confomations of ethane [CH_3—CH_3] :



(Saw horse projection)



(III) (IV)

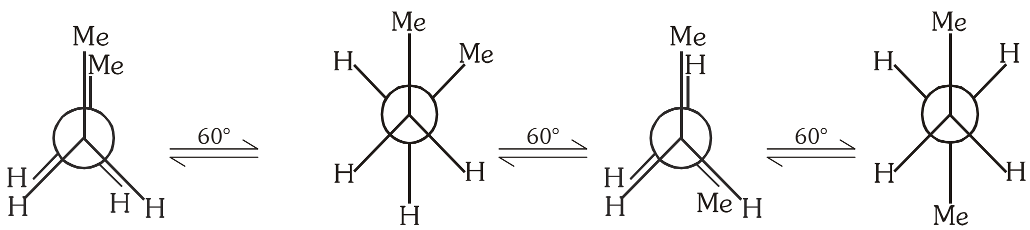
(Newman projection)

Stability order : Staggered > Eclipsed

Dihedral Angle : Dihedral angle in eclipsed form of ethane is 0°.
Dihedral angle in staggered form of ethane is 60°.

Conformation of Butane

[CH_3—CH_2—CH_2—CH_3]



(I) (II) (III) (IV)

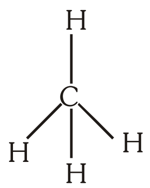
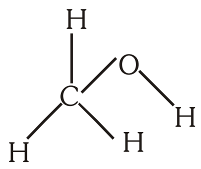
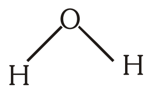
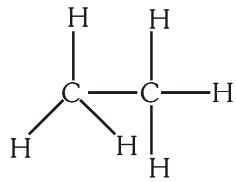
I (Fully eclipsed form) : In this form distance between 2 methyl groups is minimum so maximum repulsion or minimum stable.

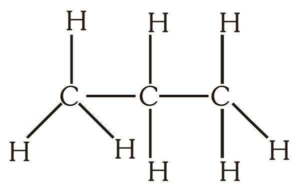
IV (Anti or staggered) : In this form distance between 2 methyl groups is maximum so minimum repulsion or maximum stable.

Stability order : IV > II > III > I

BEGINNER'S BOX-6

1. Which of the following shows conformational isomerism.

(a)  (b)  (c)  (d) 

(e) 

(1) b, d, e (2) a, b, c, e (3) b, c, d (4) c, d, e

2. Most stable conformation of butane is :-

(1) Partial eclipsed (2) Full eclipsed (3) Staggered (4) Gauche

3. Which of the following is not a pair of isomers :

(1) Propyne and Cyclopropene (2) Propyne and Propadiene

(3) Propene and Cyclopropene (4) 1-Propanol and Methoxy ethane

4. What is dihedral angle in staggered form of ethane :-

(1) 30° (2) 45° (3) 75° (4) 60°

ANSWER KEY

BEGINNER'S BOX-1	Que.	1	2	3	4	5	6	7	8
	Ans.	1	3	3	1	1	2	4	3

BEGINNER'S BOX-2	Que.	1	2	3	4
	Ans.	Z	E	E	E

BEGINNER'S BOX-3	Que.	1	2	3	4
	Ans.	3	2	1	4

BEGINNER'S BOX-4	Que.	1	2	3
	Ans.	3	4	2

BEGINNER'S BOX-5	Que.	1	2	3	4	5
	Ans.	2	2	3	2	3

BEGINNER'S BOX-6	Que.	1	2	3	4
	Ans.	1	3	3	4

EXERCISE-I (Conceptual Questions)

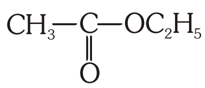
STRUCTURAL ISOMERISM

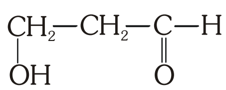
1. $CH_3CHOHCH_2CHO$ and $CH_3CH_2CH_2COOH$ constitute a pair of :-
(1) Position isomers
(2) Metamers
(3) Optical isomers
(4) Functional isomers

2. The minimum number of carbon atoms present in an organic compound to show chain isomerism is
(1) 2 (3) 3 (3) 5 (4) 4

3. The minimum number of carbon atoms present in an organic compound to be able to show position isomerism is :-
(1) 3 (2) 4 (3) 2 (4) 5

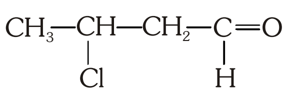
4. Which of the following compound is isomeric with propanoic acid :-

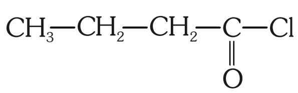
(1) 

(2) 

(3) $CH_3—CH(OH)—CH_3$
(4) $CH_3O—CH_2—CH_2OH$

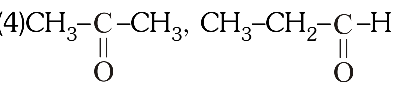
5. $CH_3—NH—C_2H_5$ and $(CH_3)_3N$ show which type of isomerism :-
(1) Position (2) Functional
(3) Chain (4) None

6.  and



are constitute a pair of :-
(1) Position isomers
(2) Metamers
(3) Optical isomers
(4) Functional group isomers

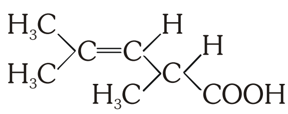
7. The minimum number of carbon atoms in ketone to show position isomerism :-
(1) 3 (2) 4 (3) 5 (4) 6

8. Which are metamers :-
(1) $CH_3–O–CH_2CH_2CH_3$, $CH_3–CH_2–O–CH_2–CH_3$
(2) $C_2H_5–O–C_2H_5$, $CH_3CH_2CH_2CH_2OH$
(3) $CH_3–O–C_2H_5$, $CH_3–CH_2–O–CH_3$
(4) 

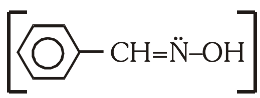
9. Which similarity is necessary for isomerism–
(1) Molecular formula
(2) Structure formula
(3) Physical formula
(4) Chemical formula

10. Number of structural isomers of C_6H_{14} is -
(1) 3 (2) 4
(3) 5 (4) 6

GEOMETRICAL AND OPTICAL ISOMERISM

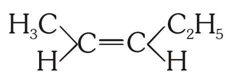
11.  Exhibits :-
(1) Tautomerism
(2) Optical isomerism
(3) Geometrical isomerism
(4) Geometrical and optical isomerism

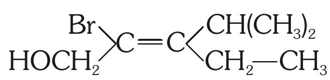
12. The isomerism shown by Benzaldoxime

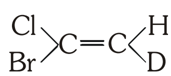
 is :-

(1) Optical (2) Geometrical
(3) Metamerism (4) All of these

13. Which of the following has Z-configuration :

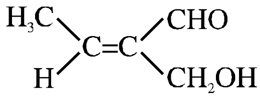
(1) 

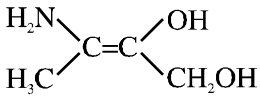
(2) 

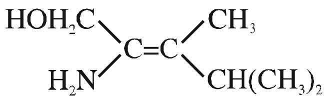
(3) 

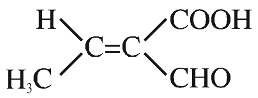
(4) All the above

14. Which of the following has E-configuration :-

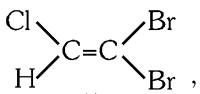
(1) 

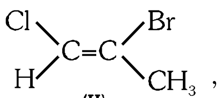
(2) 

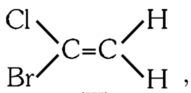
(3) 

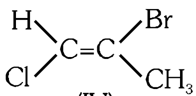
(4) 

15. Which is a pair of geometrical isomers :-


(I)

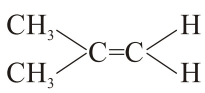
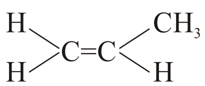
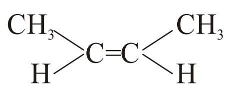
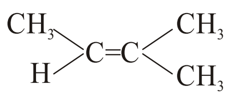

(II)


(III)

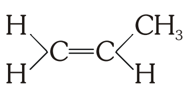
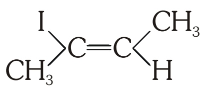
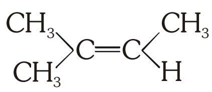
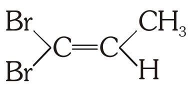

(IV)

(1) I and II (2) I and III
(3) II and IV (4) III and IV

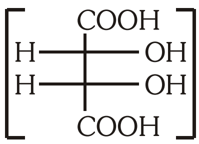
16. Which can show 'Geometrical isomerism' :-

(1) 
(2) 
(3) 
(4) 

17. Geometrical isomerism is shown by :

(1) 
(2) 
(3) 
(4) 

18. The simplest alkanol exhibiting optical activity is
(1) n-butyl alcohol (2) Isobutyl alcohol
(3) s-butyl alcohol (4) t-butyl alcohol

19. Meso–tartaric acid  is optically inactive due to the presence of :-
(1) Molecular symmetry
(2) Molecular asymmetry
(3) External compensation
(4) Two asymmetric carbon atoms

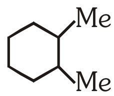
20. Which is optically active molecule :-

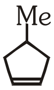
(1) $C_6H_5-\underset{\underset{O}{\|}}{C}-OH$ (2) $CH_3-\underset{\underset{OH}{|}}{CH}-C_2H_5$

(3) $C_6H_5-\underset{\underset{H}{|}}{CH}-OH$ (4) $C_6H_5-\underset{\underset{CH_3}{|}}{CH}-CH_3$

21. The number of stereo isomers of glucose (a six carbon sugar) is :-
(1) 8 (2) 12 (3) 16 (4) 24

22. Number of chiral carbon atoms in the compound X, Y and Z respectively would be :

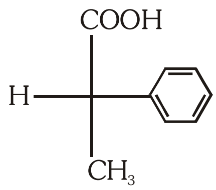
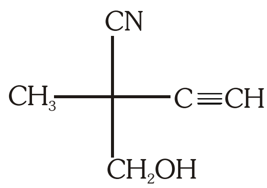
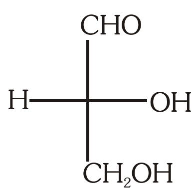
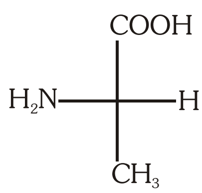
$\boxed{X} \Rightarrow$ 

$\boxed{Y} \Rightarrow$ 

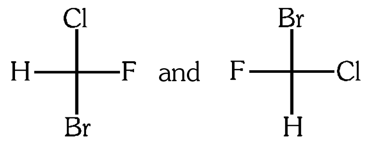
$\boxed{Z} \Rightarrow$ 

(1) 2, 1, 1 (2) 1, 1, 1
(3) 2, 0, 2 (4) 2, 0, 1

23. Identify R configuration :

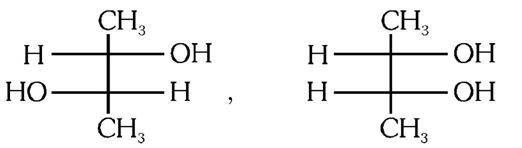
(1) 
(2) 
(3) 
(4) 

24. The following two compounds are



(1) Enantiomers (2) Diastereomers
(3) Identical (4) Epimers

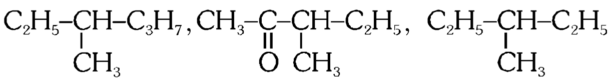
25. If optical rotation produced by the compound [A] is +65°, then produced by the compound [B] is–



[A] [B]

(1) +65° (2) –65°
(3) Zero (4) Unpredictable

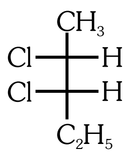
26. Among the following structure I to III



(I) (II) (III)

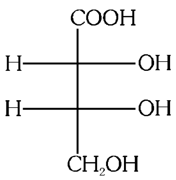
It is true that :-
(1) All three are chiral compounds
(2) Only I and II are chiral compounds
(3) Only II is chiral compound
(4) Only I and III are chiral compounds

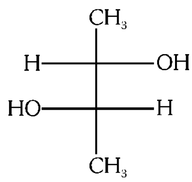
27. The absolute configuration of the compound is :

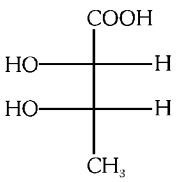


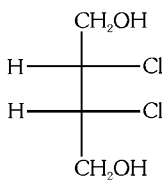
(1) 2S, 3R (2) 2S, 3S
(3) 2R, 3S (4) 2R, 3R

28. Which one of the following is a meso–compound.

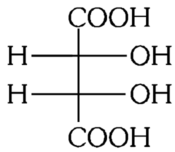
(1) 

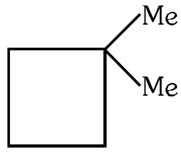
(2) 

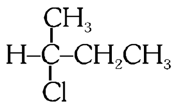
(3) 

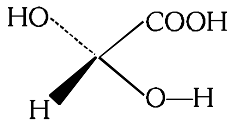
(4) 

29. Which of the following is optically active :–

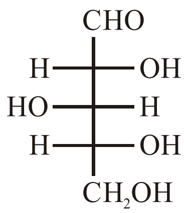
(1) 

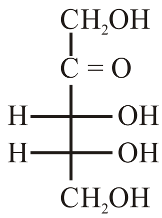
(2) 

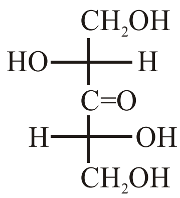
(3) 

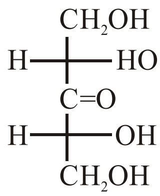
(4) 

30. Amongst the following, which one could be the structure of an optically inactive monosaccharide having the molecular weight 150 :-

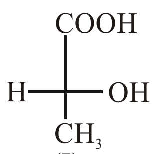
(1) 

(2) 

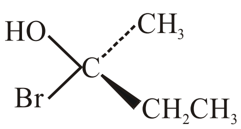
(3) 

(4) 

31. The correct configuration assigned for compounds (I) and (II) respectively are :-



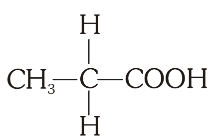
(I)

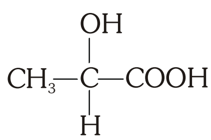


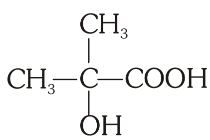
(II)

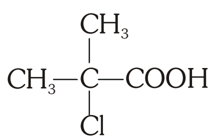
(1) R, R (2) S, S
(3) R, S (4) S, R

32. Which compound is optical active –

(1) 

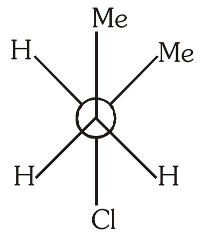
(2) 

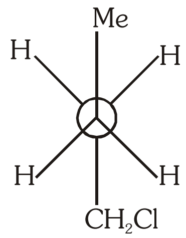
(3) 

(4) 

CONFORMATIONAL ISOMERISM

33. The pair of structures represents :-





(1) Enantiomers (2) Position isomers
(3) Conformers (4) None

34. Rotational angle require to get maximum stable conformer from minimum stable conformer in n-butane is :

(1) 360° (2) 180°
(3) 120° (4) 240°

35. Which conformation of butane will have the minimum energy :-

(1) Gauche
(2) Anti/staggered
(3) Eclipsed
(4) None

EXERCISE-I ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	**4**	**4**	**3**	**2**	**2**	**4**	**3**	**1**	**1**	**3**	**2**	**2**	**4**	**4**	**3**
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	**3**	**2**	**3**	**1**	**2**	**3**	**4**	**3**	**1**	**3**	**2**	**3**	**4**	**3**	**4**
Que.	31	32	33	34	35										
Ans.	**1**	**2**	**2**	**2**	**2**										

Directions for Assertion & Reason questions

These questions consist of two statements each, printed as Assertion and Reason. While answering these Questions you are required to choose any one of the following four responses.

(A) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.

(B) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.

(C) If Assertion is True but the Reason is False.

(D) If both Assertion & Reason are false.

1. ***Assertion :–*** The melting point of fumaric acid is higher than that of maleic acid.
Reason :– The molecules of fumaric acid are more symmetric than those of maleic acid and hence it gets closely arranged in the crystal lattice.
(1) A (2) B (3) C (4) D

2. ***Assertion :–*** trans–1–chloro propene has higher dipole moment than cis–1–chloro propene.
Reason :– The resultant of two vectors in trans–1–chloropropene is more than in cis–1–chloro propene.
(1) A (2) B (3) C (4) D

3. ***Assertion :–*** Trihydroxyglutaric acid (COOH—CHOH—CHOH—CHOH—COOH) exists in four stereoisomeric forms, two of which are optically active while the other two are meso–forms.
Reason :– It contains two asymmetric and one pseudo–asymmetric carbon atom.
(1) A (2) B (3) C (4) D

4. ***Assertion :–*** All meso form of compound are optical isomer.
Reason :– Meso form is optically inactive.
(1) A (2) B (3) C (4) D

reacting with NH_2OH.
Reason :– The two oximes arise due to geometrical isomerism around C=N bond.
(1) A (2) B (3) C (4) D

6. ***Assertion :–*** The boiling point of cis 1, 2–dichloro ethene is higher than that of corresponding trans–isomer.
Reason :– Cis– 1,2–dichloro ethene has higher dipole moment as compared to that of the trans–isomer.
(1) A (2) B (3) C (4) D

7. ***Assertion :–*** Meso tartaric acid is optically inactive.
Reason :– Its optically inactivity is due to external compensation.
(1) A (2) B (3) C (4) D

8. ***Assertion :–*** 1,2–propadiene exhibits optical isomerism.
Reason :– Its mirror image is non–superimposable.
(1) A (2) B (3) C (4) D

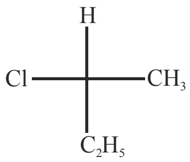
9. ***Assertion :-*** Ethanol cannot show position isomerism.
Reason :- Ethanol cannot show isomerism.
(1) A (2) B (3) C (4) D

10. ***Assertion :-*** CH_3–CH_2–Br and CH_3–CH_2–I are Functional isomers.
Reason :- The above compounds are homologues.
(1) A (2) B (3) C (4) D

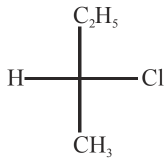
11. ***Assertion :-*** Neopentyl bromide and 2–bromo–2–methyl butane are enantiomers.
Reason :- Both have same molecular formula as well as structure formula.
(1) A (2) B (3) C (4) D

12. ***Assertion :-*** Organic compounds which do not contain chiral carbon atoms can be optically active.
Reason :- Presence of chiral carbon is an essential condition for optical activity.
(1) A (2) B (3) C (4) D

13. ***Assertion :-***



Compound - I



Compound - II

Compound-I and II are enantiomers.

Reason :- Non superimposable mirror images are enantiomers.

(1) A (2) B (3) C (4) D

14. ***Assertion :-*** cis-3-bromopropenoic acid is more stable than its trans form.

Reason :- Dipole moment of cis form is greater than trans form

(1) A (2) B (3) C (4) D

15. ***Assertion :-*** All hydrogen atoms is $CH_2=C=CH_2$ lie in one plane.

Reason :- All the carbon atoms in it are sp^2 hybridised.

(1) A (2) B (3) C (4) D

16. ***Assertion :-*** 4-Methylhex-2-ene shows stereoisomerism.

Reason :- It can show Geometrical isomerism.

(1) A (2) B (3) C (4) D

EXERCISE-II (Assertion & Reason) ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	**1**	**1**	**1**	**2**	**1**	**1**	**3**	**4**	**3**	**4**	**4**	**3**	**1**	**4**	**4**
Que.	16														
Ans.	**2**														